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SUDAN THINKING ON MAIN NILE DEVELOPMENT. pp. 19

The Development of the Main Nile for the Benefit of
Egypt and the Sudan

A. Introduction

The Main Nile

1. The object of this note is to discuss the future development of the Main Nile between Khartoum and Wadi Halfa. It is right and proper that this development shall benefit both Egypt and the Sudan, but at the same time it is only reasonable that those who live on the banks of the Main Nile shall suffer as little as possible. The plans for development which are explained below have been drawn up in accordance with these principles.
2. It is desirable that all development plans for the Main Nile should be designed to serve as many useful purposes as possible. Moreover they must be co-ordinated so as to form integral parts of a Master Plan. This emphasis on the need for co-ordinated multi-purpose development is in accordance with the best modern practice, as exemplified (for instance) by the famous Tennessee Valley Authority. It is also essential that the Master Plan for the Main Nile shall form a part of a greater Master Plan for the developing of the Nile as a whole.

The Lakes as Storage Reservoir

3. In the Great Lakes of Uganda evaporation is almost balanced by rainfall when the year is taken as a whole, and net losses are therefore negligible. This is in great contrast to Aswan where the annual evaporation loss is one of the highest in the world and rainfall is negligible. Indeed, the Main Nile as a whole is a bad place for Overyear Storage, although conditions improve slightly towards Khartoum where the rainfall becomes appreciable.
4. The conclusion to be drawn from the contrast in net evaporation losses between the Great Lakes and the Main Nile is that the latter should be used for Overyear Storage only after the former have been developed to the fullest possible extent. Transmission losses do not affect the problem, for they will usually be approximately proportional to the discharge. This means that they must be incurred sooner or later, but at the time when the water actually passes down the river will make little difference.

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5. To start by building an immense dam on the Main Nile is hydrologically unwise. The Equatorial Nile Project for Overyear Storage in the Great Lakes has been worked out in considerable detail, and is technically sound. Its main features are dams to store water in Lakes Victoria and Albert, and a bypass canal to avoid losses in the extensive swamps of the South. There is no point in impounding on the Main Nile water which could be more effectively stored in the Great Lakes.
6. Although excellent overyear-storage sites for Egypt, the Great Lakes are somewhat less suitable for the Sudan because they cannot supply water directly to the Blue Nile, upon which river the Gezira Scheme depends. For this reason Lake Tana is a better place at which to provide Overyear Storage for the Sudan. The net evaporation loss would be somewhat greater than in Uganda, but very much less than on the Main Nile. Other sites for overyear-storage dams could probably be found on the upper reaches of the Blue Nile, and, provided the silt problem could be dealt with, they ought to be better than sites on the Main Nile. For the Sudan they would have the important additional advantage of lying upstream from the main irrigation offtake.

Multi-Purpose Development

7. The main purposes for which the Main Nile can usefully be developed are as follows in order of their importance:

- (a) Irrigation
- (b) Hydro-Electric Power
- (c) Flood Protection
- (d) Navigation

Irrigation must unquestionably take pride of place, but in the past there has been a tendency to concentrate upon it almost exclusively. At the other end of the scale Navigation is undoubtedly the least important purpose, but it is not for that reason to be entirely neglected. Hitherto the great possibilities of power development on the Main Nile have not been fully appreciated, but the time has now come to take them into account. The importance of Flood Protection is obvious, but it should not be allowed to interfere seriously with plans for generating hydroelectric power.

8. In order to develop the Main Nile for any of these purposes it will be necessary to build dams, the size and position of which will depend upon the purposes in view. The sections immediately following will be devoted to considering how the dams should be planned for each separate purpose in turn. An attempt will then be made to suggest in broad outline a Master Plan for developing the Main Nile between Khartoum and Wadi Halfa. In conclusion proposals will be put forward for working out detailed plans to develop each of the dam sites suggested.

B. IrrigationGeneral Principles

9. If a storage dam is built solely for irrigation purposes its object will be to increase the natural flow of the river during the low season by impounding water during the flood. If a reservoir is emptied every year, the process is described as Annual Storage. If there is a carry-over from one year to another with the object of balancing bad floods against good ones, the process is described as Overyear Storage.
10. For Overyear Storage to be effective the capacity of the reservoir must be large, but quite apart from this the requirements of the two systems are different. For Annual Storage the distance from the dams to the offtakes of the irrigation canals should be as small as possible in order to maintain flexibility. For Overyear Storage, on the other hand, this distance is of relatively small importance, provided that always there is a balancing reservoir (which can be quite small) not far above the offtakes.
11. Other things being equal, it is desirable that net evaporation losses should be as low as possible per cubic metre of water stored. The ideal site is therefore one where a deep reservoir can store the required volume of water in a moist climate. With Overyear Storage it is particularly important to reduce the net evaporation loss, because such a reservoir will hardly ever be empty.

Annual Storage

12. On these principles Aswan is the best place on the Main Nile at which to provide annual storage for the use of Egypt. This is because the irrigated area of Egypt can be said for practical purposes to begin here, and there is no good dam site further North. There is, however, a limit to the volume of water that can be impounded at Aswan without flooding the town and district of Wadi Halfa.
13. The present position is that the full-supply level of the Aswan reservoir cannot be raised appreciably without endangering the Halfa region. Under these circumstances the best place at which to provide more Annual Storage for Egypt is the Second Cataract, which is a few kilometers above the town of Wadi Halfa.
14. In the Sudan some reaches of the Main Nile are very sparsely inhabited, but others support a dense riverain population which depends for its livelihood on irrigation water drawn from the Nile. On the former the banks are usually rocky and cataracts are common; on the latter the plains come down to the river, and irrigation can be practiced where the soil is not too sandy. The most important irrigable reaches are as follows:-

(a) For about 60 kilometres northwards from Khartoum.

- (b) From El Mugna, at the tail of the Sabaloka Gorge, to Abidiya, at the head of the Fifth Cataract.
- (c) From Shereik, at the tail of the Fifth Cataract, to Abu Hamed.
- (d) From Furi, at the tail of the Fourth Cataract, to Kerma, at the head of the Third Cataract.
- (e) From Wadi Halfa, at the tail of the Second Cataract to Egyptian Frontier.

Between Kerma and Kosha (which is near the head of the Dal Cataract) there is a certain amount of irrigation, particularly in the neighbourhood of Dalgo and Abri.

15. It follows from this description of the main irrigable reaches that the best places to provide Annual Storage for the use of the Sudan are:-

- (a) The Sabaloka Gorge, which is as near to Khartoum as local topography will allow.
- (b) The Fifth Cataract.
- (c) The tail of the Fourth Cataract, where a site at Hamdab Island has been chosen and investigated by the Egyptian Irrigation Department.
- (d) The Second Cataract, where an upstream site near Kasi has also been investigated by the Egyptian Department.

Overyear Storage on the Main Nile

16. If, as a last resort, Overyear Storage is to be provided on the Main Nile, there are two main principles to be followed in choosing sites. In the first place they should be such that none of the main irrigable reaches listed in paragraph 14 is flooded. Secondly it is desirable that the volume of water should be as large as possible for a given height of dam. The first of these principles points to Hamdab Island and the Second Cataract as suitable sites, for they both lie at the tail of a barren reach and immediately above an irrigable reach.

17. The second of the main principles for locating an overyear-storage dam calls for a site at the downstream end of a reach where the slope is relatively flat. A site of this type has been chosen by Egypt for the proposed Higher Aswan Dam, which is in this respect carefully planned. There are several such sites in the Sudan but there appears to be only one above which it is possible to impound a large volume of water without flooding a large area of irrigable land.

13. This promising site is the head of the Dal Cataract, a few miles north of Kosha. From here to the tail of the Third Cataract the slope of the river appears to be relatively flat. Between the Dal Cataract and Wadi Halfa there are a number of places that appear to favour the construction of a dam, notably the Senna Gorge. It might well be found convenient to supplement the dam at the Dal Cataract with another at the Senna Gorge.

Conclusion

14. Summarising the above discussion, we can say that dams intended to store irrigation water on the Main Nile should be sited as follows:-

- (a) Additional Annual Storage for Egypt should be at the Second Cataract.
- (b) The best sites for Annual Storage for the Sudan are the Sabloka Gorge, the Fifth Cataract, Hamdab Island and the Second Cataract.
- (c) Overyear Storage should be provided on the Main Nile only after the potentialities of the Great Lakes and of the Upper Blue Nile have been developed.
- (d) If Overyear Storage on the Main Nile is eventually found to be necessary, the best sites are Hamdab Island, the Dal Cataract, the Senna Gorge, and the Second Cataract.

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3. Summary of Proposals

Storage and Power

15. The proposals for building a series of dams on the Main Nile can be summarised as follows:-

	<u>Probably Storage</u>	<u>Probable Power</u>
	<u>Capacity in</u> <u>Milliard M3</u>	<u>Available in</u> <u>HP</u>
Sabaloka Gorge	-	50,000
Fifth Cataract	2	100,000
Hamdab Island	10	200,000
Dal Cataract	25	-----
Seman Gorge	5	250,000
Second Cataract	3	150,000
	45	750,000

All these figures are approximate, particularly those for storage capacity (except that for Hamdab Island, which alone has been accurately computed). The estimates for power available are based on 10,000 firm HP per metre drop at low water as explained in paragraph 26 above.

73. The total volume of storage capacity proposed is very much less than the suggested capacity of the reservoir behind the Higher Aswan Dam. Nevertheless, it is believed that a total storage of 45 milliards on the Main Nile would make it possible to establish an almost complete control of the river, provided that the Great Lakes were used effectively as overyear-storage reservoirs. The importance of so using them is explained in Section A above.